The Claims Defining the Invention are as Follows

1. A receiving system for connection to an antenna arrangement for detecting response signals from a substance having quadrupolar nuclei excited so as to produce nuclear quadrupole resonance therein, the system comprising:-

   an amplifier to amplify the received response signal for subsequent processing; and

   a matching section to match the amplifier to the antenna;

   wherein the matching section noise matches the receiving system to the antenna during a receiving period and reduces the Q factor of the antenna without significantly degrading the signal to noise ratio.

2. A receiving system as claimed in claim 1, wherein the matching section presents an effective lower impedance to the antenna.

3. A receiving system as claimed in claim 1 or 2, wherein said matching section comprises a damping means to damp stored transmitter energy from the antenna, without effecting further switching or configuration changes.

4. A receiving system as claimed in any one of the preceding claims, including isolating means to selectively isolate the antenna from the receiving system; the isolating means including switching means to isolate the receiving system from the antenna during a transmitting period when an excitation signal is transmitted by the antenna to irradiate the substance, and to electrically connect the receiving system to the antenna during the receiving period immediately after the transmitting period.

5. A receiving system as claimed in claim 4, wherein the isolating means is interposed between the antenna and the matching section to block the high voltage that may be generated on the antenna during the transmitting period.

6. A receiving system as claimed in claim 4 or 5, wherein the isolating means includes ¼ wave lines terminated with back to back diodes to provide isolation, in combination with nodes being set close to the amplifier by protection diodes.

7. A receiving system as claimed in claim 4 or 5, wherein the isolating means operates through a pi-network that is equivalent to a ¼ wave line in operation, terminated with back-to-back diodes

8. A receiving system as claimed in claim 4 or 5, wherein the isolating means operates on a change of inductance from a high value to a low value of impedance during the switching process, the low value of the isolating means having impedance that is less than the characteristic input impedance of the matching section.

9. A receiving system as claimed in any one of claims 4 to 8, wherein the isolating means is auto-switching, triggered by monitoring electronically an increase or decrease in input signal level beyond a threshold level.

10. A receiving system as claimed in any one of claims 4 to 8, wherein the isolating means is auto-switching, triggered by a second input that monitors electronically an increase or decrease in signal from the transmitter unit output.

11. A receiving system as claimed in any one of claims 4 to 10, wherein the isolating means is triggered by a reproducible electrical signal which is synchronised to the transmit sequence.

12. A receiving system as claimed in any one of claims 4 to 11, wherein the switching means has opening and closing characteristics shaped in time.

13. A receiving system as claimed in any one of claims 4 to 12, wherein the switching means is not frequency dependent over the general range of NQR lines of interest.

14. A receiving system as claimed in any one of claims 4 to 13, wherein said isolation means is followed by a low impedance signal receive circuit that reduces energy in the antenna and remains in the low impedance state during the entire receiving period.

15. A receiving system as claimed in any one of the preceding claims, wherein said matching section is constructed from high figure-of-merit transistors to create a close to ambient temperature thermal noise match to the antenna.

16. A receiving system as claimed in any one of the preceding claims, wherein an additional low impedance, low voltage high-speed semiconductor switch is included after said isolation means to function as a damping switch.

17. A receiving system as claimed in claim 16, wherein said damping switch has predetermined transition rates so as not to re-excite the antennae through parasitic capacitance or changes in state.

18. A receiving system as claimed in claim 16 or 17, wherein the damping switch is transistor based and is included at the input of the matching section to controllably lower the input resistance to signal ground, the damping switch being driven by a pulse synchronised to the transmit sequence.

19. A receiving system as claimed in any one of claims 16 to 18, wherein the damping switch is based on a FET or parallel FETs pulse triggering the gate or gates.

20. A receiving system as claimed in any one of claims 16 to 18, wherein the damping switch is based on a MOSFET or parallel MOSFETs where the source and drain are connected from the signal input to ground, and that a pulse to the gate triggers the damping switch..

21. A receiving system as claimed in any one of claims 16 to 20, wherein the turning on and off characteristics of the damping switch are controlled through time.

22. A receiving system as claimed in any one of the preceding claims, wherein the matching section comprises transistors that are JFETs arranged in parallel source and drain connections with their gates at signal ground.

23. A receiving system as claimed in any one of claims 1 to 21, wherein the matching section comprises a plurality of JFET transistors arranged in a cascode arrangement with a negative feedback circuit.

24. A receiving system as claimed in claim 23, bipolar transistors are provided at the source connection of the JFETs.

25. A receiving system as claimed in claim 23 or 24, wherein the negative feedback circuit is equivalent to a cold resistor.

26. A receiving system as claimed in any of claims 23 to 25, wherein the negative feedback circuit is a capacitor or inductor combination.

27. A receiving system as claimed in any of claims 23 to 25, wherein the negative feedback circuit is resistive with most of the fed-back current being conveyed away from the signal input to signal ground through a capacitive or inductive divider.

28. A receiving system as claimed in any one of the preceding claims, wherein the bandwidth of the matching section is limited in gain by a tuned circuit.

29. A receiving system as claimed in claim 28, wherein the chosen bandwidth would typically lie in a range from 1kHz to 200kHz.

30. A receiving system as claimed in any one of the preceding claims, wherein the amplifier is of negative feedback with a low noise figure.

31. A receiving system as claimed in claim 30, wherein the voltage is fed-back through a negative feedback circuit that is equivalent to a cooled resistor.

32. A receiving system as claimed in claim 31, wherein the feedback circuit is resistive with most of the fed-back current being diverted away from the signal input through a capacitive or inductive divider.

33. A receiving system as claimed in any one of the preceding claims, wherein a selected number of low forward voltage diodes, arranged back-to-back, are included at the input to signal ground of the matching section.

34. A receiving system as claimed in claim 33, wherein the diodes are of Schottky and/or Germanium type.

35. A receiving system as claimed in claim 33 or 34, wherein the diodes are DC biased to lower their cut-off voltage range.

36. A receiving system as claimed in any one of the preceding claims, including an antenna arrangement having more than one output, the voltage at each output having approximately the same magnitude.

37. A receiving system as claimed in claim 36, wherein the signal from each output passes through separate receive channels that are identical.

38. A receiving system as claimed in claim 36, wherein the signal from each output passes through separate receive channels that are not identical.

39. A receiving system as claimed in any one of claims 36 to 38, wherein the receiving antenna includes a coil with two ends, where the signal from each end is approximately equal in magnitude but opposite in polarity relative to a signal ground point located in between the two ends.

40. A receiving system as claimed in any one of claims 4 to 39, wherein the isolating means has two differential inputs and two balanced outputs with respect to ground, and the matching section has two differential inputs and a single output relative to ground.

41. A receiving system as claimed in any one of claims 36 to 39, wherein the isolating means has two differential inputs and two balanced outputs with respect to ground, the matching section has two differential inputs and two outputs, and the amplifier has two differential inputs and a single output.

42. A receiving system as claimed in any one of claims 36 to 41, wherein a further damping switch is included from the signal ground to the output of the antenna, the damping switch being triggered by a synchronized pulse to the transmit signal pulse sequence.

43. A receiving system as claimed in any one of the preceding claims, wherein the matching section is cooled to obtain improved thermal and shot noise performance.

44. A method for receiving a response signal via an antenna arrangement from a substance having quadrupolar nuclei excited so as to produce nuclear quadrupole resonance in certain of the quadrupolar nuclei, comprising: noise matching an amplifier to the antenna and lowering the Q factor of the antenna system during a receiving period when the response signal may be received by the antenna arrangement, before processing the received signal further.

45. A method as claimed in claim 44, wherein the noise matching is achieved by presenting an effective lower impedance to the antenna.

46. A method as claimed in claim 44 or 45, including damping stored transmitter energy from the antenna, without effecting further switching or configuration changes.

47. A method as claimed in claim 46, wherein said damping includes rapidly removing energy from the antenna at the start of the receiving period.

48. A method as claimed in any one of claims 44 to 47, including improving the phase stability of the response signal during the receiving period.

49. A method as claimed in any one of claims 44 to 48, including isolating the antenna arrangement during a transmitting period when an excitation signal is transmitted by the antenna to irradiate the substance, and electrically connecting the antenna arrangement to enable thermal noise matching during the receiving period.

50. A method as claimed in claim 49, wherein the isolating includes blocking the high voltage that may be generated on the antenna during the transmitting period.

51. A method as claimed in claim 49 or 50, wherein the isolating operates on changing the inductance of the from a high value to a low value of impedance during the switching process, the low value having impedance that is less than the characteristic input impedance of the matching.

52. A method as claimed in any one of claims 44 to 51, including the cycle of maintaining a high Q on the antenna during the transmitting period, followed immediately by a low Q during the entire receiving period for any data gathering transmit signal pulse sequence in the field irradiating the substance.

53. A receiving system substantially as herein described with reference to the accompanying drawings as appropriate.

54. A method for receiving a response signal substantially as herein described with reference to the accompanying drawings as appropriate.